Space Weather Forecast

Issued on Monday, 29 January 2024 at 12:56 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Increased chance of Minor or Moderate (R1/R2) radio blackouts. Possible glance from CME and Minor Geomagnetic Storm G1 midweek UTC. Minor Solar Radiation Storm S1 in course.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity rose sharply to Moderate in the past 24 hours, with previously subdued occasional Common-class X-ray activity showing an increased cadence and amplitude to culminate in a Moderate-class flare from a large and complex sunspot region in the northwest at 29/0438UTC. This was a long-period flare and was accompanied by an energetic Coronal Mass Ejection (CME), an 'EUV wave' (rapidly-propagating ripple in extreme UV wavelengths across the Sun). This CME showed a 'shock' (envelope of interplanetary matter interacting with the CME), however the main thrust of the CME is expected to pass west of the Earth, crossing the radius of the Earth's orbit early in the UTC day of Wednesday 31 January.

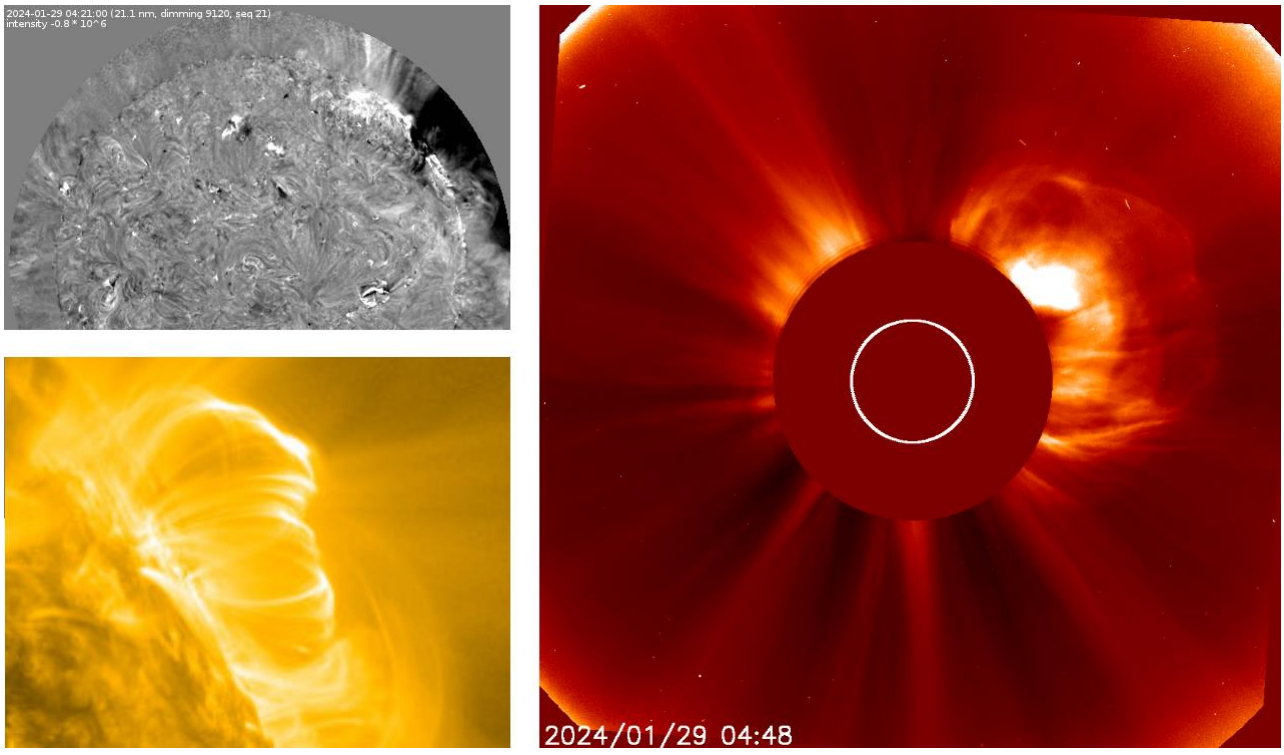

Figure 1: Selected false colour imagery from the Moderate-class flare from the large sunspot at 29/0438UTC: clockwise from top left: SIDC ROB time integrated coronal dimming; satellite imagery of the resulting CME envelope (heading left, i.e. at least partially ahead of the Earth in its orbit) and the post-eruptive arcade – a proxy for the magnetic field reconnecting after the CME's departure.

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The above sunspot region was one of up to five on the current Earth-facing side. Because most of the current regions now lie near the solar horizons, monitoring ability is more limited for the narrow viewing angle, however strong growth in the leading spots of the most active sunspot region was observed in the current UTC morning, with a significant span of 20 degrees solar longitude still identifiable. The most significant active regions of the remainder of the front side were a new arriving region in the far northeast, which appears bright in extreme UV imagery and magnetically bipolar.

No 'filament eruptions' (arcs of plasma leaving the Sun) were noted on imagery in the period, with by far the largest event being the Moderate class X-ray flare-tied CME. Imagery for the event has been good. Some influence from the shock is likely on Wednesday 31 January - see the 'Geomagnetic Activity' section for further details.

Solar Wind / Geomagnetic Activity: Solar winds showed a probable emerging weak fast wind regime as of the start of the current reporting period (i.e. around 28/1200UTC). The cause of this enhancement is unclear - but perhaps either a coronal hole in the northwest which is perhaps at too high a solar latitude but a more suitable solar longitude; or else one nearer the solar equator, which is expected to influence Earth, but is perhaps a little early for its current position. This has corollaries for the forecast discussed in the 'Geomagnetic Activity' section.

The solar wind rose from background levels to become slightly elevated in the current UTC day. The number of particles in the solar wind was less clear (hence the uncertainty), but this nevertheless stayed within background levels. The associated magnitude of the solar wind magnetic field was greatest to start the period (slightly elevated), with the north-south component varying with an erratic character.

The net result of the above solar wind measures was for provisionally mainly quiet geomagnetic activity.

Energetic Particles / Solar Radiation: High energy protons (solar radiation storms) showed a sharp and almost immediate rise across all measured energies in the wake of the large X-ray flare, with 10MeV peaking and subsequently plateauing at 33pfu around 29/0900UTC, while 100MeV has thus far risen to 0.6pfu. This implies a relatively direct connection to Earth at present, as also hinted at by the 'snow' observed on some satellite imagery following the event (caused by energetic protons hitting the detector).

Four-Day Space Weather Forecast Summary

Solar Activity: There is now an increased daily chance of Moderate-class flares and a slight chance of Strong-class flares as a result of increased activity in the large sunspot group in the northwest. This risk may show a step-change downwards around midweek UTC as this region departs, with uncertain contributions from eastern solar horizon arrivals due in the four days.

Solar Wind / Geomagnetic Activity: There is a slight chance of Minor Geomagnetic Storm G1 from a possibly inbound fast wind enhancement in the first 36 hours of the forecast, although this is now lowered relative to recent guidance for possibly already being in course. There then follows a peak risk of G1 for the period due to the 29/0438UTC Moderate X-ray flare-tied CME, the associated shock passes the radius of Earth's orbit early in the UTC day of Wednesday 31 January and offers a peak chance of G1 as a result.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain above Minor Solar Radiation Storm S1 in the immediate term, with a decreasing chance then following

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through the first half of the UTC working week as levels wane. The residual risk is then slightly higher than previously advertised for later in the UTC week given this precedent for activity, albeit by then starting to decrease as the large sunspot responsible will be - by then - rotating away from a geoeffective position.

Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	50	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	50	50	40	30
Very Active	R3 to R5 X	No	10	10	5	1

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	Yes	100	50	25	10
Very Active	≥ S3 *	No	5	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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